

1 (a) exposing an in vivo region of a subject to a magnetic polarizing field, the in
2 vivo region including non-neural tissue that [may] include blood vessels and a nerve, the nerve being a
3 member of the group consisting of peripheral nerves, cranial nerves numbers three through twelve,
4 and autonomic nerves;

5 (b) exposing the in vivo region to an electromagnetic excitation field;

6 (c) sensing a resonant response of the in vivo region to the polarizing and
7 excitation fields and producing an output indicative of the resonant response;

8 (d) performing the steps (a), (b), and (c) a second time to produce an output in
9 which the conspicuity of blood vessels is enhanced; and

10 (e) processing said output indicative of the resonant response and said output in
11 which the conspicuity of blood vessels is enhanced to generate a data set describing the shape and
12 position of said nerve, said data set distinguishing said nerve from non-neural tissue, in the in vivo
13 region to provide a conspicuity of the nerve that is at least 1.1 times that of the non-neural tissue,
14 without the use of neural contrast agents.--

15 REMARKS

16 Introduction

17 In response to the final Action of October 17, 1995, applicants:

- 18 1. Propose cancellation of rejected independent Claims 139-149;
- 19 2. Propose amendment of rejected independent Claim 89 in a manner discussed during a
20 telephonic interview with the Examiner on March 7, 1996; and
- 21 3. Propose new Claims 164-168, which place in independent form claims that were
22 deemed allowable, but subject to objection for dependency upon one or more rejected claims.

23 Matters Concerning Application Drawings

24 In reviewing the application file, the undersigned attorney noted that: (1) the attorney
25 previously responsible for the application submitted drawing amendments for consideration by the

1 Examiner (Preliminary Amendment dated March 14, 1994) but did not submit the proposed drawing
2 changes to the Office Draftsperson; and (2) a Petition under 37 C.F.R. 1.84(b) is required for use of
3 photographs in the application drawings, but was not previously filed.

4 By separate letter, substitute formal drawings are being transmitted to the Office
5 Draftsperson. A copy of the drawings with changes being shown in red ink accompany this
6 amendment. Also enclosed with this amendment is a photocopy of the Petition for use of
7 Photographs that is being submitted to the United States Patent and Trademark Office under separate
8 cover. The drawings being submitted differ from the originally submitted drawings in the following
9 ways:

10 1. Formal Sheet 1 of the drawings, which includes FIGURES 1, 12, 13A and 13B, is
11 arranged with the respective Figures in a landscape mode. In addition, all images of Sheet 1 (the
12 drawing of FIGURE 1 and the photographs of FIGURES 12, 13A and 13B) are mirror images of the
13 originally submitted FIGURES 1, 12, 13A and 13B. The photographic images displayed by the
14 submitted substitute FIGURES of Sheet 1 reflect proper photographic printing of the associated
15 photographic film. The copies originally submitted were inadvertently printed in reverse image.

16 2. Reference numeral "12" and an accompanying lead line have been added to FIGURE 6
17 to generally indicate the depicted medical system. The use of numeral "12" to refer to the medical
18 system is included in applicants' specification at, for example, page 11, lines 17 and 18.

19 3. Reference numeral "58" in FIGURE 7 has been changed to --52-- for correspondence
20 with the reference numeral used in the specification, for example, on page 13, lines 28 and 29 to refer
21 to the MISCELLANEOUS SUPPRESSION block of FIGURE 7.

22 4. In FIGURE 8, a lead line has been added from the reference numeral "14" to the
23 dashed box surrounding the electoral magnetic coils to thereby indicate the MRI system in the manner
24 referenced in the specification at, for example, page 14, lines 13 and 14. A lead line also has been
25 added from the reference numeral "60" to the associated polarizing field coil. A reference

1 numeral --61-- and an accompanying lead line have been added to more clearly point out the field coil
2 shown in the lowermost position in FIGURE 8. Moreover, a lead line has been added from the
3 reference numeral "64" to the corresponding gradient coil, which is described in the specification at
4 page 14, lines 34 and 35. A lead line also has been added from the reference numeral "62" to the
5 excitation coil, reflecting the description in the specification at page 14, lines 16 and 17. The
6 reference numeral --58-- has been added, with an accompanying lead line, to indicate the stabilizing
7 splint in FIGURE 8, which is described at page 14, lines 7-19.

8 5. The reference numeral 132 and an associated lead line have been added to FIGURE 10
9 to indicate the inquiry step described at page 22, lines 15-17 of the specification.

10 6. FIGURE 11A has been revised to reduce the height of the pulse D to approximately
11 1/2 of the height of the pulse E, which corresponds to the description in the specification at page 18,
12 lines 32-34.

13 7. References --LVR-- and --CF-- (with associated lead lines) have been added to
14 FIGURE 23 to respectively indicate the left ventral root and the cerebrospinal fluid in the depicted
15 cross-section of a vertebra. In addition, the reference "DJ" has been replaced with --DS-- for
16 correspondence with the dural sac described in the specification at page 41, line 18. The
17 reference "VR" and its accompanying lead line have been deleted, since they are not required nor
18 described in the specification.

19 It is to be noted that the drawings being submitted for approval by the Examiner and the
20 corresponding substitute formal drawings being sent to the Office Draftsperson do not include two
21 features of the drawings that were provided to the Examiner with applicants' communication of
22 March 14, 1994 (but not previously submitted to the Office Draftsperson). Specifically, FIGURE 8
23 of the earlier submitted drawings includes a graphically changed representation of the polarizing field
24 coils 60. That change has not been made in the accompanying formal drawings because it is not
25 needed and might raise an inference of "new matter." Further, FIGURE 9 of the drawings informally

1 submitted on March 14, 1994 included incorrect ("scrambled") legends in Blocks 112, 114, 116,
2 and 118. The incorrect legends were an inadvertent error by the patent illustrator that prepared the
3 drawings. The FIGURE 9 that is now being submitted is correct and corresponds to FIGURE 9 as
4 originally filed.

5 Since each of the above proposed changes clarify the drawings and provide strict
6 correspondence with the specification, approval by the Examiner is respectfully requested.

7 Submission of Documents

8 At page 8-9 of the Office Action, the Examiner notes that prior art submitted with IDS (Paper
9 No. 15) on May 8, 1995 "is unfortunately not with the present application." Pursuant to the
10 Examiner's request, applicants include a copy of the following documents that are listed in the May 8,
11 1995 IDS:

12 DE 3639140 A1	5/1987	Germany
13 WO 87/01199	2/1987	PCT
14 WO 91/17454	11/1991	PCT
15 Howe, F.A. et al. "Magnetic Resonance Neurography" Magnetic 16 Resonance in Medicine 28:328, 338 (1992).		

17 It should be noted that the co-inventors of the subject matter disclosed and claimed in the
18 application (Drs. Howe and Filler) are named as authors of the above-identified article that appears in
19 Magnetic Resonance and Imaging. More important, it should be noted that the technical article is not
20 prior art since this application was filed on March 8, 1993 (claiming earlier priority) and the technical
21 article clearly shows that a proposed draft was not event received by the publication until August 6,
22 1992. Thus, even if applicants' priority claim is disregarded, the noted technical article could not
23 possibly have disclosed the applicants' invention more than one year prior to the time at which a
24 patent application was filed. Inclusion of the technical article in the earlier submitted IDS was an
25 oversight that occurred when applicants' counsel listed all documents that were listed by the European
Patent Office with regard to a PCT Preliminary Examination.

1 Applicants' Proposed Amendment of Independent Claim 89

2 As is noted in an Examiner Interview Summary Record (mailed March 12, 1996; Paper
3 No. 18), a telephonic interview took place on March 7, 1996 in which applicants' representative
4 proposed two changes to rejected independent Claim 89. The first change was amendment of part (a)
5 of Claim 89 to specify that the recited nerves include epineurium and perineurium. The second
6 proposed change was amendment of part (e) of Claim 89 to specify a conspicuity of the imaged nerve
7 that is at least 1.1 times that of any adjacent non-neural tissue. As is noted in the Examiner Interview
8 Summary Record, the Examiner agreed that the noted change to part (e) of Claim 89 appeared to
9 define over the Hajnal et al. reference if sufficiently supported by the specification.

10 Applicants have amended parts (a) and (e) in the manner proposed during the telephonic
11 interview. With respect to support in the specification, the Examiner's attention is directed to:
12 page 8, lines 16-20 ("some embodiments in the invention are able to make all other structures in the
13 body including bone, fat, skin, muscle, blood, and connective tissues tend to disappear so that only
14 the nerve tree remains to be seen."); page 8, line 32-page 9, line 2 ("... actually results in the nerve
15 signal being more intense than any other tissue."); page 11, lines 23-25 ("the images may selectively
16 exclude all other structures within the specimen."); page 21, lines 14-17 ("... producing an image
17 depicting only the peripheral nerve."); and page 32, lines 21-28 ("... nerves are brighter than any
18 other structure in the image.").

19 In view of the above-noted examples, applicants believe that there is more than sufficient
20 support in the specification for amending independent Claim 89 to specify a conspicuity that is at
21 least 1.1 times that of "any adjacent non-neural tissue" Accordingly, applicants believe that, as
22 amended, independent Claim 89 is in condition for allowance.

23 The Newly Submitted Claims Are Claims That Were Subject Only To Objection And Include All Of
24 The Limitations Of The Base Claims And Any Intervening Claims

25 In the Office Action of October 17, 1995, Claims 92-96, 99, 100, 103, 104, 106, 107, and
111-113 were objected to as being dependent upon a rejected base claim, but would be deemed

1 allowable if rewritten in independent form including all the limitations of the base claim and any
2 intervening claims. As is demonstrated below, new submitted Claims 64-68 each incorporate
3 limitations set forth in a claim that was subject to objection, the base claim for that claim and, in
4 addition, all intervening claims.

5 Applicants are submitting newly proposed Claim 164, which includes all the limitations of
6 canceled Claim 103 and Claim 89, upon which Claim 103 directly depended. Specifically, new
7 Claim 164 has been drafted to recite all limitations of Claim 103 and all limitations of Claim 89
8 (except the language relating to "dura mater or cerebrospinal fluid," which the Examiner suggested be
9 removed from Claim 89. In that regard, the limitation relating to spin-spin relaxation coefficient
10 previously set forth in dependent Claim 103 has been incorporated in part (d) of newly submitted
11 independent Claim 164.

12 Newly proposed independent Claim 165 incorporates all limitations previously set forth in
13 Claim 92, base Claim 89, and intervening Claim 91. Specifically, newly submitted Claim 165
14 corresponds to previously submitted Claim 89 with language being added to parts (a), (c), and (e) to
15 define the first and second gradients originally recited in Claims 91 and 92; the production of first and
16 second outputs that correspond to the first and second gradients; and subtraction of the first output
17 from the second output to generate the recited data set.

18 Newly presented Claim 166 includes all limitations of Claim 96, the previously submitted
19 Claim 89 and intervening Claim 91. In particular, proposed Claim 166 incorporates all limitations of
20 previously submitted independent Claim 89 with the language of part (a) being modified to specify
21 that the magnetic polarizing field includes a "predetermined arrangement of gradients," part (c) being
22 modified to specify that the recited step of "producing an output" includes the step of "producing a
23 separate output for each diffusion-weighted gradient of said predetermined arrangement of gradients,"
24 and part (e) being modified to specify that the recited processing includes "vector processing the
25

1 separate outputs . . . to generate data representative of anisotropic diffusion exhibited by the nerve,
2 and processing said data representative of said anisotropic diffusion to generate said data set . . ."

3 Newly proposed Claim 167 includes all of the limitations of Claim 99, base Claim 89 and
4 intervening Claim 97. In particular, newly submitted Claim 167 corresponds to previously submitted
5 independent Claim 89 with part (a) being modified to specify that the recited non-neural tissue
6 includes fat and part (e) being expanded to include a virtually verbatim recitation of the language of
7 dependent Claim 99.

8 Newly submitted independent Claim 168 includes all the limitations recited in dependent
9 Claim 111, base Claim 89 and intervening Claim 110. In drafting newly submitted Claim 168, the
10 applicants have incorporated into previously submitted independent Claim 89 recitation that the in
11 vivo region specified in part (a) "may include blood vessels." Applicants also have modified part (d)
12 to state that steps (a), (b), and (c) are performed a second time to produce an output in which the
13 conspicuity of blood vessels is enhanced. Further, applicants have amended part (e) to call for
14 processing of both the "output indicative of the resonant response" and the "output in which
15 conspicuity of blood vessels is enhanced."

16 Since newly submitted Claims 164-168 each define subject matter deemed patentable if placed
17 in independent claim format, applicants believe each of those claims to be in condition for allowance.

18 Claim 104 (which is being amended to depend from newly submitted Claim 164), Claims 93
19 and 95 (which are being amended to depend from newly submitted Claim 165), and Claims 98
20 and 100 (which are being amended to depend from newly submitted Claim 167) are believed in
21 condition for allowance because each of these claims depend from an allowable independent claim and
22 because at least a portion of the claims set forth additional limitations that distinguish applicants'
23 invention over the prior art.
24
25

1 Claims 90, 91, 92, 96, 97, 99, 103, 108-115, 118 and 119 each depend from amended
2 independent Claim 89 and are believed allowable both because of such pendency and because at least
3 a portion of the claims include features that are patentably distinct from the prior art.

4 Conclusion

5 Claim 89, which has been amended in a manner agreed upon during a telephonic interview is
6 in condition for allowance since the specification supports the amendment proposed during the
7 telephonic conference. Claims 90, 91, 92, 96, 97, 99, 103, 108-115, 118 and 119 are believed in
8 condition for allowance because each of these claims depends from amended Claim 89 and because at
9 least a portion of the claims further distinguish applicants' invention over the prior art. Newly
10 submitted Claims 164-168 are believed in condition for allowance because each of these claims is a
11 replacement for a claim that the Examiner deemed allowable, if rewritten in independent form that
12 includes all limitations in the respective chains of dependency. Claims 104, 106 and 107, which
13 depend from newly submitted Claim 64 are allowable because of dependency upon newly submitted
14 Claim 164. Further, Claims 104, 106 and 107 are believed to set forth additional patentable subject
15 matter. Claims 98 and 100, each depended upon newly submitted Claim 167 are believed allowable
16 because a dependency upon an allowable claim and because of recitation of additional nonobvious
17 features of applicants' invention. Claims 102, 117, 120-138 and 150-163 already have been deemed
18 to be in condition for allowance. For the above summarized reasons, applicants believe that all claims
19 of the application are now in condition for allowance (Claims 89-100, 102-104, 106-115, 117-138
20 and 150-168). Accordingly, applicants respectfully request entry of this amendment, reconsideration
21 by the Examiner, allowance and early passage to issuance.

22 Applicants also request approval of the above described drawing changes.

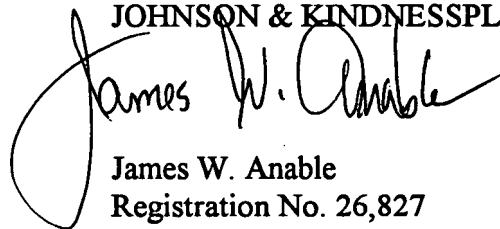
23 Upon issuance, applicants suggest that the claims be issued in the following sequence:

- | | | |
|-----------------|--------------|--------------|
| 24 1. Claim 162 | 4. Claim 104 | 7. Claim 165 |
| 25 2. Claim 102 | 5. Claim 106 | 8. Claim 93 |
| 3. Claim 164 | 6. Claim 107 | 9. Claim 94 |

10. Claim 95	29. Claim 111	48. Claim 132
11. Claim 166	30. Claim 112	49. Claim 133
12. Claim 167	31. Claim 113	50. Claim 134
13. Claim 98	32. Claim 114	51. Claim 135
14. Claim 100	33. Claim 115	52. Claim 136
15. Claim 168	34. Claim 118	53. Claim 137
16. Claim 163	35. Claim 119	54. Claim 138
17. Claim 117	36. Claim 120	55. Claim 150
18. Claim 89	37. Claim 121	56. Claim 151
19. Claim 90	38. Claim 122	57. Claim 152
20. Claim 91	39. Claim 123	58. Claim 153
21. Claim 92	40. Claim 124	59. Claim 154
22. Claim 96	41. Claim 125	60. Claim 155
23. Claim 97	42. Claim 126	61. Claim 156
24. Claim 99	43. Claim 127	62. Claim 157
25. Claim 103	44. Claim 128	63. Claim 158
26. Claim 108	45. Claim 129	64. Claim 159
27. Claim 109	46. Claim 130	65. Claim 160
28. Claim 110	47. Claim 131	66. Claim 161

Respectfully submitted,

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Enclosures:

Copy of Substitute Formal Drawings (17 Sheets - unmarked)
7 Sheets of Drawings w/red ink changes
Copy of Petition to Accept Photographs
3 References, 1 Article

CERTIFICATION OF HAND DELIVERY

I hereby certify that this correspondence is being hand delivered to the U.S. Patent Office, Group Art Unit
3305 to Examiner B. Casler on March 25, 1996

Date: March 25, 1996


(signature)

JWA:teb